

CLAIMS

- 1 1. A method of guiding a sleep pattern of a sleeper, the method comprising:
2 monitoring at least one physiological characteristic of a sleeper; and
3 generating at least one sensory stimulus to pace the sleeper.

- 1 2. The method of claim 1, further comprising:
2 varying the at least one sensory stimulus;
3 comparing the variations in the sensory stimulus to the at least one physiological
4 characteristic of the sleeper;
5 determining if the sensory stimulus is pacing the sleeper.

- 1 3. The method of claim 2, further comprising varying the at least one sensory
2 stimulus to lead the sleeper.

- 1 4. The method of claim 2, further comprising:
2 varying the at least one sensory stimulus after it is determined that the sensory
3 stimulus is pacing the sleeper;
4 comparing the variations in the sensory stimulus after the sleeper is being paced
5 to the at least one physiological characteristic of the sleeper;
6 determining if the sensory stimulus is leading the sleeper.

- 1 5. The method of claim 4, further comprising monitoring the at least one
2 physiological characteristic of the sleeper until it is determined that the sleeper has been
3 successfully led to a destination sleep stage.

1 6. A method of guiding a sleep pattern of a sleeper, the method comprising:
2 monitoring at least one physiological characteristic of a sleeper indicative of a
3 current sleep stage of the sleeper; and
4 generating a sensory stimulus to lead the sleeper to a sleep stage different from
5 the current sleep stage.

1 7. The method of claim 6, wherein monitoring the physiological characteristic
2 comprises monitoring at least one of heart rate, blood pressure, brain wave pattern,
3 muscle tension, eye movement, respiration, body temperature, blood flow, blood oxygen
4 level, blood chemistry, noisiness, moisture, body position and body motion.

1 8. The method of claim 6, further comprising determining which sleep stage the
2 sleeper is in prior to generating the sensory stimulus.

1 9. The method of claim 6, wherein generating the sensory stimulus comprises
2 generating at least one of an audible sound, a visible light, a vibration, an electric shock,
3 and an environmental adjustment.

1 10. The method of claim 9, wherein the environmental adjustment comprises at least
2 one of a temperature change, a change in air flow, a change in ambient light, and a
3 change in ambient noise.

1 11. The method of claim 6, further comprising determining whether the sleeper has
2 moved to the different sleep stage subsequent to generating the sensory stimulus.

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1 12. The method of claim 6, wherein generating the sensory stimulus to lead the
2 sleeper comprises pacing the sleeper by generating a sensory stimulus in response to each
3 measured change in the physiological characteristic that exceeds a predetermined
4 threshold.

1 13. The method of claim 12, wherein generating the sensory stimulus to lead the
2 sleeper further comprises adjusting a characteristic of the sensory stimulus generated.

1 14. The method of claim 13, wherein adjusting the characteristic of the sensory
2 stimulus generated comprises adjusting the sensory stimulus generation to affect at least
3 one physiological characteristic of the sleeper to lead the sleeper to the different sleep
4 stage subsequent to generating the sensory stimulus.

1 15. The method of claim 14, further comprising monitoring the physiological
2 characteristic to determine whether generating the sensory stimulus is encouraging the
3 sleeper to enter the different sleep stage.

1 16. The method of claim 6, wherein generating the sensory stimulus to lead the
2 sleeper comprises generating the sensory stimulus to lead the sleeper from a non-rapid
3 eye movement sleep stage to a rapid eye movement sleep stage.

1 17. The method of claim 6, further comprising calibrating to the sleeper's sleep
2 pattern by monitoring the physiological characteristic of the sleeper for at least one full
3 sleep cycle prior to generating the sensory stimulus.

1 18. The method of claim 17, wherein calibrating to the sleeper's sleep pattern further
2 comprises determining at least one physiological characteristic indicative of when the
3 sleeper is changing from one sleep stage to another sleep stage.

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1 19. The method of claim 6, further comprising indicating a sleep period duration for
2 monitoring the physiological characteristic and generating sensory stimuli throughout the
3 sleep period duration at selected intervals to guide the sleeper through sleep stages so that
4 the sleeper is in a sleep stage near an awake stage of sleep around an end of the sleep
5 period duration.

1 20. The method of claim 19, wherein generating sensory stimuli throughout the sleep
2 period duration at selected intervals comprises generating sensory stimuli continuously
3 throughout the sleep period duration to guide the sleeper through sleep.

1 21. The method of claim 6, further comprising generating a sensory stimulus in
2 response to the monitored physiological characteristic of the sleeper to establish a rapport
3 with the sleeper.

1 22. The method of claim 21, further comprising monitoring the sleeper's response to
2 the sensory stimulus to establish a rapport to determine if the sleeper is pacing with the
3 sensory stimulus.

1 23. The method of claim 6, further comprising generating a sensory stimulus to pace
2 the sleeper.

1 24. The method of claim 23, wherein pacing the sleeper comprises pacing the
2 physiological characteristic of the sleeper.

1 25. The method of claim 6, further comprising establishing a personalized sleeper
2 profile including at least one data reference indicating a sensory stimulus setting for the
3 sleeper and referencing that data reference when generating the sensory stimulus to lead
4 the sleeper.

1 26. The method of claim 6, wherein the sensory stimulus stimulates the sleeper's
2 touch sense.

1 27. The method of claim 6, wherein the sensory stimulus stimulates the sleeper's
2 smell sense.

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1 28. The method of claim 6, wherein the sensory stimulus stimulates the sleeper's
2 sight sense.

1 29. The method of claim 6, wherein the sensory stimulus stimulates the sleeper's
2 hearing sense.

1 30. The method of claim 6, wherein the sensory stimulus stimulates the sleeper's taste
2 sense.

1 31. The method of claim 6, wherein the at least one physiological characteristic
2 monitored is indicative of a sleep stage associated with sleep apnea of the sleeper and the
3 sensory stimulus generated is generated to lead the sleeper to a sleep stage not associated
4 with the sleeper's sleep apnea.

1 32. The method of claim 6, wherein the at least one physiological characteristic
2 monitored is indicative of a sleep stage associated with sleepwalking by the sleeper and
3 the sensory stimulus generated is generated to lead the sleeper to a sleep stage not
4 associated with the sleeper's sleepwalking.

1 33. The method of claim 6, wherein the at least one physiological characteristic
2 monitored is indicative of a sleep stage associated with bedwetting by the sleeper and the
3 sensory stimulus generated is generated to lead the sleeper to a sleep stage not associated
4 with the sleeper's bedwetting.

1 34. The method of claim 6, wherein the at least one physiological characteristic
2 monitored is indicative of a sleep stage associated with nightmares of the sleeper and the
3 sensory stimulus generated is generated to lead the sleeper to a sleep stage not associated
4 with the sleeper's nightmare.

1 35. The method of claim 6, wherein the at least one physiological characteristic
2 monitored includes at least two physiological characteristics monitored.

1 36. The method of claim 35, wherein the at least two physiological characteristics
2 monitored include a plurality of physiological characteristics monitored.

- 1 37. A method of guiding a sleep pattern of a sleeper between NREM and REM sleep,
2 the method comprising:
3 monitoring at least one physiological characteristic of the sleeper indicative of
4 NREM sleep;
5 generating a sensory stimulus having at least one characteristic configured to lead
6 the sleeper to enter REM sleep; and
7 monitoring the physiological characteristic to determine whether the sensory
8 stimulus was effective to lead the sleeper to enter REM sleep.
- 1 38. The method of claim 37, further comprising:
2 generating a sensory stimulus to pace the sleeper's sleep;
3 leading the sleeper to enter NREM sleep after the sleeper is pacing; and
4 monitoring the physiological characteristic to determine whether the sleeper
5 entered NREM sleep.
- 1 39. The method of claim 38, further comprising monitoring the sleeper's response to
2 determine if the sleeper is pacing with the sensory stimulus.
- 1 40. The method of claim 38, wherein pacing the sleeper's sleep comprises pacing the
2 physiological characteristic of the sleeper.
- 1 41. The method of claim 37, further comprising:
2 determining that a first change in the physiological characteristic of the sleeper is
3 indicative of NREM sleep and that a second change in the physiological
4 characteristic of the sleeper is indicative of the sleeper entering REM
5 sleep; and
6 guiding the sleeper to enter REM sleep from NREM sleep by leading the sleeper
7 to experience the second change in the physiological characteristic
8 indicative of the sleeper entering REM sleep.

1 42. The method of claim 37, further comprising generating a sensory stimulus in
2 response to the monitored physiological characteristic of the sleeper to establish a rapport
3 with the sleeper.

1 43. The method of claim 37, further comprising establishing a personalized sleeper
2 profile including at least one data reference indicating a sensory stimulus setting for the
3 sleeper and referencing that data reference when generating the sensory stimulus to lead
4 the sleeper.

1 44. The method of claim 37, wherein the sensory stimulus stimulates the sleeper's
2 touch sense.

1 45. The method of claim 37, wherein the sensory stimulus stimulates the sleeper's
2 smell sense.

1 46. The method of claim 37, wherein the sensory stimulus stimulates the sleeper's
2 sight sense.

1 47. The method of claim 37, wherein the sensory stimulus stimulates the sleeper's
2 hearing sense.

1 48. The method of claim 37, wherein the sensory stimulus stimulates the sleeper's
2 taste sense.

1 49. The method of claim 37, wherein the at least one physiological characteristic
2 monitored includes at least two physiological characteristics monitored.

1 50. The method of claim 49, wherein the at least two physiological characteristics
2 monitored include a plurality of physiological characteristics monitored.

1 51. A sleep pattern adjustor comprising:
2 a physiological characteristic monitor;
3 a sensory stimulus generator; and
4 a processor operatively associated with the physiological characteristic monitor
5 and the sensory stimulus generator, the processor configured to receive
6 input from the physiological characteristic monitor indicative of a first
7 sleep stage of a sleeper and provide output to the sensory stimulus
8 generator to cause the sensory stimulus generator to generate at least a first
9 sensory stimulus in response to the input received from the physiological
10 characteristic monitor to lead the sleeper from the first sleep stage to a
11 second sleep stage.

1 52. The sleep pattern adjustor of claim 51, wherein the physiological characteristic
2 monitor is configured to monitor at least one physiological characteristic of the sleeper,
3 the at least one physiological characteristic comprising at least one of heart rate, blood
4 pressure, brain wave patterns, muscle tension, eye movement, respiration, body
5 temperature, blood flow, blood oxygen level, blood chemistry, noisiness, body position
6 and body motion

1 53. The sleep pattern adjustor of claim 51, wherein the processor is further configured
2 to pace a sleeper in the one sleep stage by generating at least a second sensory stimulus in
3 response to a measured change in at least one physiological characteristic monitored
4 through the physiological characteristic monitor, and lead the sleeper to the other sleep
5 stage by adjusting a characteristic of the second sensory stimulus generated.

1 54. The sleep pattern adjustor of claim 53, wherein the processor is further configured
2 to receive feedback through the physiological characteristic monitor indicating whether
3 the sleeper is following the lead to the other sleep stage, and to further adjust the
4 characteristic of the sensory stimulus generated to further cause the sleeper to change to
5 the other sleep stage.

1 55. The sleep pattern adjustor of claim 51, wherein the sensory stimulus generator is
2 configured to generate at least one of an audible sound, a visible light, a vibration, an
3 electric shock, and an environmental adjustment.

1 56. The sleep pattern adjustor of claim 55, wherein the environmental adjustment
2 comprises at least one of a temperature change, a change in air flow, a change in ambient
3 light, and a change in ambient noise.

1 57. The sleep pattern adjustor of claim 51, wherein the processor is configured to lead
2 the sleeper from a non-rapid eye movement sleep stage to a rapid eye movement sleep
3 stage.

1 58. The sleep pattern adjustor of claim 51, wherein the processor is further configured
2 to calibrate to the sleeper's sleep pattern by monitoring at least one physiological
3 characteristic of the sleeper for at least a portion of a sleep cycle prior to the sensory
4 stimulus generator generating sensory stimuli.

1 59. The sleep pattern adjustor of claim 58, wherein the processor is further configured
2 to calibrate to the sleeper's sleep pattern by determining at least one physiological
3 characteristic indicative of when the sleeper is changing between sleep stages.

1 60. The sleep pattern adjustor of claim 51, wherein the processor is further configured
2 to receive an input indicating a sleep period duration for monitoring the physiological
3 characteristic and to generate sensory stimuli throughout the sleep period duration at
4 selected intervals to guide the sleeper through at least the first and second sleep stages so
5 that the sleeper is in a sleep stage near an awake state around an end of the sleep period
6 duration.

1 61. The sleep pattern adjustor of claim 60, wherein the processor is further configured
2 to generate sensory stimuli continuously throughout the sleep period duration to guide the
3 sleeper through sleep.

1 62. The sleep pattern adjustor of claim 51, wherein at least one of the physiological
2 characteristic monitor and the sensory stimulus generator communicates with the
3 processor using wireless technology.

1 63. The sleep pattern adjustor of claim 51, wherein the processor is further configured
2 to generate a sensory stimulus in response to the monitored physiological characteristic of
3 the sleeper to establish a rapport with the sleeper.

1 64. The sleep pattern adjustor of claim 63, wherein the processor is further configured
2 to monitor the sleeper's response to the sensory stimulus and generate a responsive
3 sensory stimulus to establish a rapport and pace the sleeper with the sensory stimulus.

1 65. The sleep pattern adjustor of claim 51, wherein the processor is further configured
2 to generate a sensory stimulus to pace at least one physiological characteristic of the
3 sleeper.

1 66. The sleep pattern adjustor of claim 51, wherein the processor is further configured
2 to generate a sensory stimulus to lead the sleeper to another sleep stage.

1 67. The sleep pattern adjustor of claim 51, wherein the processor is further configured
2 to reference a personalized sleeper profile for the sleeper and generate sensory stimulus
3 in accordance with the sleeper's personalized sleeper profile.

1 68. The sleep pattern adjustor of claim 51, wherein the sensory stimulus generator is
2 configured to stimulate the sleeper's touch sense.

1 69. The sleep pattern adjustor of claim 51, wherein the sensory stimulus generator is
2 configured to stimulate the sleeper's smell sense.

1 70. The sleep pattern adjustor of claim 51, wherein the sensory stimulus generator is
2 configured to stimulate the sleeper's sight sense.

1 71. The sleep pattern adjustor of claim 51, wherein the sensory stimulus generator is
2 configured to stimulate the sleeper's hearing sense.

1 72. The sleep pattern adjustor of claim 51, wherein the sensory stimulus generator is
2 configured to stimulate the sleeper's taste sense.

1 73. The sleep pattern adjustor of claim 51, wherein the processor is configured to
2 receive input indicative of a sleep stage associated with the sleeper experiencing sleep
3 apnea and provide output to generate sensory stimulus in response to the input received to
4 lead the sleeper to a different sleep stage not associated with the sleeper experiencing
5 sleep apnea.

1 74. The sleep pattern adjustor of claim 51, wherein the processor is configured to
2 receive input indicative of a sleep stage associated with the sleeper sleepwalking and
3 provide output to generate sensory stimulus in response to the input received to lead the
4 sleeper to a different sleep stage not associated with the sleeper sleepwalking.

1 75. The sleep pattern adjustor of claim 51, wherein the processor is configured to
2 receive input indicative of a sleep stage associated with the sleeper wetting the bed and
3 provide output to generate sensory stimulus in response to the input received to lead the
4 sleeper to a different sleep stage not associated with the sleeper wetting the bed.

1 76. The sleep pattern adjustor of claim 51, wherein the processor is configured to
2 receive input indicative of a sleep stage associated with the sleeper having a nightmare
3 and provide output to generate sensory stimulus in response to the input received to lead
4 the sleeper to a different sleep stage not associated with the sleeper having a nightmare.

1 77. The sleep pattern adjustor of claim 51, wherein the physiological characteristic
2 monitor monitors at least two physiological characteristics.

1 78. The sleep pattern adjustor of claim 77, wherein the physiological characteristic
2 monitor monitors a plurality of physiological characteristics.

1 79. The sleep pattern adjustor of claim 51, wherein the processor is configured to
2 store a personalized sleep profile and generate the sensory stimulus in accordance with
3 data from the personalized sleep profile.

1 80. The sleep pattern adjustor of claim 79, wherein the personalized sleep profile
2 comprises data indicative of the sleeper's sleep stages and data indicative of the stimuli to
3 which the sleeper responds for pacing and leading the sleeper from the first sleep stage to
4 the second sleep stage.

1 81. An apparatus for guiding a sleep pattern of a sleeper to change between NREM
2 and REM sleep, the apparatus comprising:
3 a physiological characteristic monitor configured to monitor at least one
4 physiological characteristic of a sleeper;
5 a sensory stimulus generator configured to generate at least one sensory stimulus
6 in response to the physiological characteristic of the sleeper; and
7 a processor operatively associated with the physiological characteristic monitor
8 and the sensory stimulus generator, the processor configured to receive
9 input from the physiological characteristic monitor indicative of a NREM
10 sleep stage, and provide output to the sensory stimulus generator to lead
11 the sleeper to change to a REM sleep stage.

1 82. The apparatus of claim 81, wherein the processor is further configured to receive
2 input from the physiological characteristic monitor indicative of the REM sleep stage,
3 and provide output to the sensory stimulus generator to lead the sleeper to change to the
4 NREM sleep stage.

1 83. The apparatus of claim 81, wherein the processor is further configured to
2 determine which physiological characteristic of the sleeper is indicative of the NREM
3 sleep stage and which physiological characteristic of the sleeper is indicative of the
4 sleeper entering the REM sleep stage, and to guide the sleeper to enter the REM sleep
5 stage by causing the sensory stimulus generator to generate the at least one sensory
6 stimulus to lead the sleeper to experience the physiological characteristic indicative of the
7 sleeper entering the REM sleep stage.

1 84. The apparatus of claim 81, wherein the processor is further configured to calibrate
2 to the sleeper's sleep patterns and to calculate an optimal sleep pattern related to an
3 amount of time remaining in a preselected sleep period duration.

1 85. The apparatus of claim 84, wherein the processor is further configured to guide
2 the sleeper through the optimal sleep pattern by causing the sensory stimulus generator to
3 generate the at least one sensory stimulus responsive to the physiological characteristic of
4 the sleeper to pace the sleeper, adjusting at least one characteristic of the sensory stimulus
5 generated to lead the sleeper, and determine whether the sleeper is following the lead by
6 monitoring the physiological characteristic of the sleeper through the physiological
7 characteristic monitor.

1 86. The apparatus of claim 81, wherein the processor is further configured to
2 reference a personalized sleeper profile for the sleeper and the sensory stimulus generator
3 is configured to generate sensory stimulus in accordance with the sleeper's personalized
4 sleeper profile.

1 87. The apparatus of claim 81, wherein the at least one physiological characteristic
2 monitored includes at least two physiological characteristics monitored.

1 88. The apparatus of claim 87, wherein the at least two physiological characteristics
2 monitored include a plurality of physiological characteristics monitored.

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